

**00495**

**1980/01/24**

PROTOCOL BETWEEN  
THE NATIONAL SCIENCE FOUNDATION OF  
THE UNITED STATES OF AMERICA  
AND THE GEOLOGICAL SURVEY OF  
THE DEPARTMENT OF INTERIOR OF  
THE UNITED STATES OF AMERICA  
AND THE STATE SEISMOLOGICAL BUREAU OF  
THE PEOPLE'S REPUBLIC OF CHINA  
FOR SCIENTIFIC AND TECHNICAL COOPERATION  
IN EARTHQUAKE STUDIES

The National Science Foundation of the United States of America, the Geological Survey of the Department of the Interior of the United States of America, and the State Seismological Bureau of the People's Republic of China (hereinafter referred to as the Parties), in accordance with the Agreement between the Government of the United States of America and the Government of the People's Republic of China on Cooperation in Science and Technology, signed in Washington, D.C., on January 31, 1979, agree in this Protocol to pursue cooperation in the fields of earthquake prediction, earthquake hazards evaluation, earthquake engineering, and other basic and applied studies of earthquake phenomena as follows:

ARTICLE 1

The Parties agree to conduct exchanges and other cooperative activities on the basis of equality, reciprocity and mutual benefit.

ARTICLE 2

The Parties agree that cooperation may include such areas of mutual interest as acquisition, interpretation, and

evaluation of geological and geophysical data; installation and operation of geophysical instruments and the processing and interpretation of data therefrom for the study of earthquakes; application of geological and geophysical techniques, including geologic mapping and tectonic analysis, to the study of faults, earthquake source zones, and geologic conditions that affect the propagation of seismic waves; installation and operation of instrumentation for the study of strong ground shaking required for progress in earthquake engineering; laboratory, theoretical, and numerical studies of the geologic and physical processes preceding, accompanying and following earthquakes; post-earthquake damage surveys; theoretical, analytical, numerical and experimental (both laboratory and in situ) studies of structural and soil responses during earthquake excitation; fundamental studies directed at a thorough understanding of the natural phenomena involved; and other areas of mutual interest.

### ARTICLE 3

The Parties agree that cooperation may include the following forms:

- (1) Exchange of scientists, specialists, delegations, and of scientific and technical information;
- (2) Cooperative research on subjects of mutual interest, including devising and installing of instruments and equipment and the analysis of data therefrom;
- (3) Joint organization of scientific conferences, symposia and lectures;

(4) Such other forms of cooperation as are mutually agreed.

#### ARTICLE 4

The cooperative activities carried out under this Protocol will be subject to the availability of funds and manpower for all Parties. The specific tasks, obligations and conditions with respect to the above-mentioned activities, including responsibility for the payments of costs shall be decided by mutual agreement on a case-by-case basis. Each year, the Parties shall arrange, through a meeting or exchange of correspondence, the exchange of personnel to be involved. Upon mutually acceptable terms one Party may send additional personnel to the other side. Participants will pay all expenses of their dependents.

#### ARTICLE 5

Activities under this Protocol shall be conducted under the guidance of the US-PRC Joint Commission on Scientific and Technological Cooperation established pursuant to the aforementioned Science and Technology Agreement. In order to implement this Protocol, each Party shall designate a representative to be responsible for determining the directions and scope of cooperation and for ensuring the effectiveness of cooperation and exchange. The representatives of the Parties or their designated coordinators will, by correspondence, consult with each other and define the cooperative activities and other related matters. When necessary, a meeting may be

convened by mutual agreement, to consider matters related to the implementation of this Protocol.

#### ARTICLE 6

Scientific and technical information transmitted by one Party to another Party under Article 3 of this Protocol shall be accurate to the best of the knowledge and belief of the transmitting Party, but the transmitting Party does not warrant the suitability of the scientific and technical information transmitted for any particular use or application by the receiving Party or by any third Party.

#### ARTICLE 7

Scientific and technical information derived from cooperative activities under this Protocol may be made available, unless otherwise agreed in an Annex under Article 8 of this Protocol, to the world scientific community through customary channels and in accordance with the normal procedures of the Parties.

#### ARTICLE 8

- (1) The specific activities as mutually agreed, and the terms under which they will be conducted, including financial arrangements, shall be embodied in Annexes to this Protocol. New cooperative programs will be confirmed by correspondence between the representatives

of the Parties, and such new agreements will be attached as Annexes to this Protocol. In the case of any inconsistency between the terms of this Protocol and the terms of an Annex hereto, the terms of this Protocol shall be controlling.

- (2) The National Science Foundation and the Geological Survey of the Department of the Interior of the U.S. shall coordinate the participation of other U.S. agencies and entities, including, but not limited to, the National Oceanic and Atmospheric Administration, in the cooperative activities under this Protocol. The State Seismological Bureau and the Office of Earthquake Resistance of the State Capital Construction Commission of the PRC shall coordinate the participation of other Chinese agencies in the cooperative activities under this Protocol. All agencies' participation in the cooperative activities under this Protocol shall be restricted by the terms of this Protocol.

#### ARTICLE 9

In accordance with Article 5 of the aforementioned agreement signed January 21, 1979, between the Governments of the United States of America and the People's Republic of China, the Parties agree to reach an accord respecting treatment of inventions, discoveries, and information subject to copyright arising under this Protocol. Such accord shall be reached within six months

if the entry into force of this Protocol and shall become an Annex hereto.

#### ARTICLE 10

Title to any equipment sent by one side to the other side shall remain with the sending side, during or after the period of this Protocol, any Party to this Protocol may abandon any piece of equipment in place without further obligation or transfer the title to any other Party on such terms, including sale, gift or barter, as the Parties agree.

The Parties agree to use their best efforts to assist in all reasonable ways, efforts by any Party to procure and export on commercial terms to the territory of another Party equipment that is necessary for this Protocol.

#### ARTICLE 11

This Protocol shall enter into force upon signature, and shall remain in force for a five-year period. It may be amended or extended by mutual agreement of the Parties. The termination of the Protocol shall not affect the validity or duration of projects under this Protocol which are initiated prior to such termination.

Done at Beijing, this 24th day of January, 1980, in  
duplicate in the English and Chinese languages, both texts  
being equally authentic.

FOR THE U.S. GEOLOGICAL SURVEY OF  
THE DEPARTMENT OF THE INTERIOR  
OF THE UNITED STATES OF AMERICA

FOR THE STATE SEISMOLOGICAL  
OF THE PEOPLE'S REPUBLIC OF

William W. Hayward

邵 73.

FOR THE NATIONAL SCIENCE FOUNDATION  
OF THE UNITED STATES OF AMERICA

Richard Atkinson



ANNEX I  
TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL  
COOPERATION IN EARTHQUAKE STUDIES

INVESTIGATIONS OF PREMONITORY PHENOMENA  
AND TECHNIQUES FOR EARTHQUAKE PREDICTION

I. General

The purpose of this annex is to establish cooperative scientific programs concerned with observations of phenomena that are possible earthquake precursors, and with techniques of earthquake prediction based on such observations.

A detailed implementation plan, which will specify timetable, participants, division of financial and logistic support, location of observations, techniques of data reduction, arrangements for data analysis, and other relevant matters will be prepared by the parties for each program.

II. Potential Research Programs

The following list suggests some of the phenomena for which programs of observation, data reduction, and data analysis may be planned. Other phenomena can be added.

- seismicity: search for techniques for prediction using seismic observations
- deformation: search for possible features of land deformation for use as precursors, including gravity measurements, leveling, trilateration, triangulation, studies of fault creep (using alignment arrays of creepmeters), and instrumental strain measurements.

- geomagnetism: research for the physical basis of an earthquake-magnetic effect as well as its prospects as an approach to prediction.
- geochemistry of fluid phases: search for geochemical precursors in wells and springs.
- well monitoring: search for precursory behavior in changes in the level and quality of water in wells.
- electrical measurements: search for precursory behavior in electrical properties as deduced from measurements of natural and induced electric fields.
- fundamental studies of earthquake process and its precursory mechanism.

The initial objective of the joint work will be to supplement existing and planned systems of earthquake prediction measurements in two regions of the PRC and thereby increase their overall effectiveness. This approach will lead to mutual advantage in that the Chinese side will benefit from an enhanced instrumental, observation and analysis capability and the U.S. side will benefit from the experience gained from the integrated system of observations and from experience with Chinese methods of analysis. Work will be focused in two regions: The Beijing-Tianjin Region (114 degrees - 120 degrees E; 38.5 degrees - 41 degrees N) and the West Yunnan Region (99.5 degrees - 101 degrees E; 25 degrees - 27 degrees N). Joint work will be developed in a step-by-step manner to assure effective utilization of resources, building each new step upon the experience gained in previous steps.

To supplement existing and planned instrumental networks in the Beijing-Tianjin and Western Yunnan Regions, the U.S. side will provide agreed equipment and instrumentation, and train Chinese personnel in its operation as agreed in the implementing plans. The PRC side will be responsible for providing capital construction, for installing instruments and equipment and for routine operation, and will bear related costs.

### III. Programs 1980-1981

#### 1. Seismological Observation:

(a) The first steps will be to develop the capability of real-time detection and location and seismic data analysis for the seismic-network in the Beijing-Tianjin Region and to develop a system of portable digital seismic event recorders and seismic data analysis for the Western Yunnan Region.

The real-time detection and location capability in the Beijing-Tianjin Region will be centered around a computer with the analytic capability equal to or greater than a digital equipment PDP 11/34. All reasonable efforts will be made to obtain a computer with capability equal to or greater than a digital equipment PDP 11/44. The computer will be equipped with peripherals appropriate for seismic data analysis, and other related cooperative research. Detailed arrangements for this computer system, including peripherals, will be developed based on technical discussions between the parties and available funds. The computer and peripherals will be procured in 1980, but the procurement of some may extend into 1981. A plan to share the maintenance of the computer and peripherals will be developed. The capability of the system

and resources permit.

The system for Western Yunnan Province will consist initially of 10 digital event recorders with capability equal to or greater than the Geotech MCR 500 and a computer with analytic capability equal to or better than a Hewlett-Packard System 45B with peripheral equipment appropriate for seismic data analysis. This equipment will be procured during 1980.

In 1981, based upon the development of the work in Yunnan Province, the capabilities for seismic data analysis and processing in cooperative research will be increased appropriately. If efforts currently underway at the USGS to develop a programmable hardware device for the automatic detection of P-Wave arrivals are successful, if the plans of the SSB are to install a telemetered network in Western Yunnan and if funds are available, one of the USGS systems capable of detecting P-Wave arrivals on at least 64 channels will be provided for the Western Yunnan Region in 1981.

If the work with digital event recorders in Western Yunnan proves successful, and if funds are available, the USGS will provide 10 digital event recorders with capability equal to or greater than the Geotech MCR 600 for work in the Beijing-Tianjin Region in 1981 or 1982.

(b) Also during 1980, the sides will exchange small groups of researchers to study the data on each side, to exchange methods of interpretation and research results, and to plan experiments using the equipment described above.

(a) During 1980 the feasibility of joint deformation measurements will be investigated. Techniques to be investigated, with emphasis on the Western Yunnan Region, will include the installation of alignment arrays or creepmeters to measure fault creep and the establishment of small-scale trilateration networks.

If the feasibility of measuring strain using small-scale trilateration networks is demonstrated in 1980, and if funds are available, the U.S. side will provide two electronic distance measuring devices equivalent to or better than a Hewlett-Packard HP 3808A in 1981. The Chinese side will investigate the possibility of obtaining the services of an aircraft to make measurements of temperature and humidity along the line of sight for large-scale trilateration measurements. If this proves possible, a joint plan for such measurements will be developed.

(b) In the second half of 1980, the U.S. will send a small group of scientists to China for 2 months to investigate some seismic regions in North and Northeast China. Arrangements will be made whereby both sides may exchange during the visit viewpoints, methods and research results about relevant subjects of mutual interest (such as research on the mechanism of some strong earthquakes in North China, based on the evolution of regional deformation field and regional tectonics).

(c) In 1981, China will send a small group of scientific workers to the U.S. for 2 months to investigate the Palmdale Uplift Region in Southern California and deformation surveys

and geology along the San Andreas Fault. During their visit, arrangements will be made whereby both sides may exchange viewpoints, methods and research results on relevant subjects of mutual interest (such as the cause of the Southern California Uplift).

### 3. Magnetic Measurement

During 1980, the feasibility of joint magnetic measurement systems will be investigated. A system of three to five portable 5-10 day recording magnetometers will be used for magnetic surveys in both the Beijing-Tianjin and Western Yunnan Regions.

If these measurements are successful and funds are available, the U.S. side will provide five portable recording magnetometer systems each for the Beijing-Tianjin and Western Yunnan Regions in 1981.

If funds are available, 10 telemetered magnetometers will be installed in the Western Yunnan Region in 1981 or 1982.

### 4. Preparation of Implementation Plans and Initiation of Work During 1980

For the programs listed above, the PRC side will send a small group of scientific and technical personnel to the U.S. to learn the instrumentation and techniques of data processing and analysis, to discuss selection of instruments, and to prepare a detailed implementation plan for programs under

this annex; the U.S. side will send a small group of scientific and technical personnel to China to complete detailed implementation plans, to investigate and discuss selection of sites to carry out feasibility studies, and to install instruments and equipment together with Chinese technical personnel.

## ANNEX 2

### TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL COOPERATION IN EARTHQUAKE STUDIES

#### INVESTIGATION OF INTRA-PLATE ACTIVE FAULTS AND EARTHQUAKES

##### I. Items for Cooperation

- (1) Comparative study of seismogenic structures in the western part of the U.S. and North China (including field investigation, interpretation and analysis of satellite photographs, paleomagnetic measurements, mechanical analysis of rock structure).
- (2) Investigations of earthquake recurrence by study of historic and prehistoric ancient earthquakes by trenching, age dating, and other techniques.
- (3) Study of occurrence of great earthquakes, focal mechanisms, and distribution of intraplate seismicity.
- (4) Study of the relations of Pacific plate motion to seismicity in the Western U.S. and East China.
- (5) Seismotectonic and geologic investigations in Western Yunnan Province.

II. 1980-1981 Program -- Topics will be selected from the following list with scheduling and size of groups to be determined on a year-by-year basis.

- (1) Investigation of the Tanglu Fault in relation to earthquakes: A group from the U.S. side will go to China for joint field investigations and discussion of data and theories. A group from the Chinese side will go to the U.S. to take part in laboratory studies, such as paleomagnetic measurement, mechanical analysis of rock structure and interpretation of satellite images in this region.



(2) Investigation of the relation of earthquakes to the San Andreas Fault system to the U.S.: A group from the Chinese side will go to the U.S. for joint field investigations, to engage in laboratory studies, such as paleomagnetic measurement, interpretation of satellite images, and mechanical analysis of rock structure.

(3) Investigation of ancient earthquakes and traces of historic earthquakes in several localities in China

(Southern Ningxia Province) and their chronological dating: a small group from the U.S. side will go to China for joint field investigation, including trenching and other studies. Subsequently, a small group will be sent from the Chinese side to the U.S. to participate in chronological dating by various techniques and other laboratory studies.

(4) Investigation of historical and prehistorical earthquakes and their seismo-geological traces in several paleoseismic areas of U.S. (selected localities in California, Nevada and Missouri): A group from the Chinese side will go to the U.S. for joint field investigations and to engage in research and experimental analysis.

(5) Seismotectonic and geologic investigations in Western Yunnan Province: A small group from the U.S. side will join Chinese scientists in geologic investigations to determine the geologic origin, role of deformation and recurrence time of large earthquakes in the region of Western Yunnan to be instrumented jointly under Annex 1.

## ANNEX B

### TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL COOPERATION IN EARTHQUAKE STUDIES

#### COOPERATIVE RESEARCH ON EARTHQUAKE ENGINEERING AND HAZARDS MITIGATION

##### I. General

This annex presents selected areas for cooperative research on earthquake engineering and hazards mitigation under this Protocol. Detailed bilateral plans including research tasks and financial and other requirements for each specific activity will be presented in a joint proposal. Joint proposals will be prepared by the performing institution and/or scientists and the corresponding counterpart. The selected topics presented below do not exclude other cooperative activities or projects which might be deemed desirable by the Parties for inclusion under this Protocol. Financial support for individual projects by NSF will depend on evaluation of research proposals and the availability of funds.

##### II. Objective and Scope

(1) Installation and deployment of arrays of strong-motion instruments in China. Consideration will be given to the following:

1-A: A mobile array of digital and/or analog strong-motion accelerographs with an instrument and service base at a major city such as Beijing. The array is to be deployed after a major event for the purpose of capturing ground motion data due to large earthquakes and aftershocks. The array might also be employed if a prediction or warning of a major earthquake were issued.

1-B: A local dense strong-motion instrument array to be deployed possibly in the Beijing-Tianjin area, for recording data of surface and downhole motions due to earthquakes.

1-C: A composite array to be deployed in Southwestern China near the Sichuan-Yunnan border area for the purpose of observing the effects of source mechanisms, propagation paths and site conditions on ground motion. The measuring instruments, accessories and associated training of technicians for the aforementioned strong-motion arrays will be provided by the U.S. side while the PRC side will provide costs for the support of local scientific and technical manpower, materials, and supplies required for the site investigation and preparation, instrument installation, maintenance and operation. Both sides shall share the support and the data on an approximately equal basis.

(2) Establishment of facilities in China for processing strong-motion records. On the basis of mutual support, the U.S. side shall provide, whenever necessary and possible, assistance in technology, software and hardware facilities to the PRC for the establishment of a strong-motion data processing center. The U.S. will make available the necessary hardware facilities upon mutually accepted terms.

(3) Study of ground motion characteristics of destructive earthquakes (including seismic risk and microzonation analyses). Joint projects shall be developed and conducted on the basis of collaboration of theoretical, analytical, and field studies. Both sides shall provide the necessary seismological, geological and ground motion data when available. This data includes preinstrumental seismicity and site characteristics. Specific sites and regions for cooperative study shall be selected jointly.

4. Study of structural response, reliability, failure mechanisms, and design of structures (including brittle, ductile, massive and extended systems) under the action of large earthquakes. The study shall be organized in consideration of the status of current theoretical and computational investigations and the field experiences and experimental conditions in both countries. Balance shall be maintained between the respective interests of both sides in the material and structural types considered and in the selected methods of analysis. Equal emphasis should be placed on theoretical developments and practical applications. Types of structures and facilities to be studied might include:

- (a) earthen dams;
- (b) hydroelectric power generation systems;
- (c) unreinforced masonry structures;
- (d) underground conduits, cavities, and dwellings;
- (e) network systems for transportation, transmission of power and energy and water supply;
- (f) off-shore, harbor, pile supported structures, and inland water structures, and
- (g) industrial, commercial and residential structures.

Under mutually agreed terms, the U.S. side shall provide technical assistance to the PRC for the establishment of experimental capabilities in structural dynamics as required in these joint research projects. The U.S. side will make available the necessary equipment upon mutually accepted terms.

(5) Study of the earthquake resistance of soils and soil structures with emphasis on such problems as the liquefaction of sand and the dynamic response of silty soils and soft clays. The following considerations may apply in these joint studies:

(a) Both sides shall provide field data of soil deformation and failure due to recent earthquakes and conduct in situ and laboratory tests of soil samples;

(b) Both sides shall conduct appropriate dynamic tests of soil samples and models using shaking tables, centrifuges, and other appropriate laboratory equipment, and

(c) Both sides shall correlate and interpret the results. Under mutually agreed terms, the U.S. side shall provide technical assistance to the PRC side for the establishment of experimental capabilities in soil dynamics as required for joint research. The U.S. side will make available the necessary equipment upon mutually accepted terms.

(6) Study of technology for urban earthquake hazards reduction. The following considerations may be included to study measures for urban earthquake hazards through urban planning and architectural design:

(a) The study of effects of building and infrastructure system failures on life safety and recovery;

(b) The study of measures to decrease vulnerability of infrastructure systems in urban areas;

(c) The study of mitigation measures for critical facilities such as hospitals, police and fire stations and communication systems;

(d) The study of techniques for seismic reliability identifications, reinforcement, and other alternative procedures for reducing vulnerability of existing structures;

(e) The development of techniques for assessing vulnerability of habitational structures;

... of planning and management of strong motion measuring systems for reducing vulnerability of buildings and infrastructure systems in urbanized areas including both pre- and post-earthquake contexts.

### III. Implementation Plan for the Year 1980

(1) The PRC side shall send several persons to the U.S. to investigate the design and management of strong-motion instruments and maintenance and installation of strong-motion instruments and data processing. The U.S. side shall send several persons for participation in the design of the proposed arrays and in-field reconnaissance of proposed instrument sites. The objectives of this exchange will be to make concrete plans to:

(a) design networks; determine balances between fixed and mobile instruments and between types and numbers of instruments to be deployed; and select areas for initial instrumentation.

(b) Share experiences and plan for processing and analysis of the data obtained from the networks.

(2) The U.S. side shall provide a limited number of strong-motion measuring instruments for the mobile array and the PRC shall provide the manpower, facilities and funds needed for installation, operation, and maintenance of the scientific and technical studies.

(3) The PRC side shall send an appropriate number of scientists, engineers, and researchers in the field of earthquake engineering and hazard mitigation to the U.S. to investigate the design and use of earthquake simulators and other laboratory and field facilities for studying the

response of structures and soils under earthquake loading and to study mitigation efforts. The U.S. side will send an appropriate number of engineers, architects, and planners to investigate or to participate in joint studies.

(4) Develop a plan to permit joint teams of experts to conduct cooperative analyses of structure and soil failures at an agreed time in earthquake-damaged areas acceptable to both the PRC and U.S.

(5) Study the feasibility and identify common interest areas in societal response research for earthquake hazards mitigation.

#### IV. 1981 Plans

(1) Complete initial deployment of instrumentation in mobile and/or fixed arrays in manner and regions as determined in 1980.

(2) Continue projects started in 1980 and initiate some additional above-mentioned items of cooperative study.

(3) Increase the exchange of scientific information and personnel.

(4) Conduct a workshop on seismic analysis and design of reinforced concrete structures including methods for the identification, evaluation and reinforcement of existing hazardous buildings. The workshop shall be in the Summer of 1981, in the U.S.

(5) Conduct a workshop on microzonation techniques and their implementation for earthquake hazards reduction in Spring or Fall of 1981 in China.

(6) Prepare a bilateral joint conference on earthquake engineering during the Summer of 1982, in China.

TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL  
COOPERATION IN EARTHQUAKE STUDIES

COOPERATIVE RESEARCH PROJECTS ON DEEP CRUSTAL STRUCTURE

I. General

This annex presents selected study areas for cooperative research on deep crustal structure. A detailed bilateral proposal including financial and other relevant requirements for each specific project will be presented for consideration by each side. Joint proposals will be prepared by the performing institution and/or scientist and the corresponding counterpart. The selected study areas below do not exclude other cooperative activities or projects which might be deemed desirable by the parties for inclusion under this protocol.

II. Objective

To use a variety of approaches to improve understanding of deep crustal structure; to study the conditions and geodynamic processes leading to earthquakes; to study earthquake source mechanisms; and to study related geophysical problems.

III. Scope

To map deep crustal structure detail using natural earthquake data, reflection and refraction profiling, gravity surveys, heat flow surveys, and various magnetic and electrical techniques.

IV. Implementation Plan for 1980-1981

- (1) The PRC side shall send several investigators to the U.S. to observe and participate in a seismic reflection profiling experiment and related data processing and interpretation.
- (2) The U.S. side shall send several investigators to the PRC to conduct appropriate field surveys and to collect data in support of the objectives of this annex.



## ANNEX 5

### TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL COOPERATION IN EARTHQUAKE STUDIES

#### COOPERATIVE RESEARCH PROJECTS ON LABORATORY STUDIES IN ROCK MECHANICS

##### I. General

This annex presents selected study areas for cooperative research on laboratory studies related to rock mechanics. A detailed bilateral proposal including financial and other relevant requirements for each specific project will be presented for consideration by each side. Joint proposals will be prepared by the performing institution and/or scientists and the corresponding counterpart. The selected study areas below do not exclude other cooperative activities or projects which might be deemed desirable by the parties for inclusion under this protocol.

##### II. Objective

To model thermodynamic conditions of deep crustal structure in the laboratory; to study geophysical characteristics of rocks, particularly the mechanism of fracture, in order to understand deep crustal structure and the earthquake process; and to provide accurate explanations for earthquake precursors.

##### III. Scope

Cooperative studies shall include (but not be limited to):

(A) The variation of physical properties of rock during the fracturing process (elastic wave velocity, electrical resistivity, permeability, volumetric dilatancy, and the temporal

(B) The mechanics of pressurized creep, stick slip, and  
fault gouge.

(C) The effect of pore fluids and partial melting at high  
pressure and temperature.

Research proposals under this annex may contain the purchase  
or development of laboratory equipment necessary for the  
conduct of the research.

#### IV. Implementation plan for 1980-1982

(A) In 1980 and 1981, the PRC side will send several persons  
to relevant laboratories in the U.S. for cooperative studies  
on mutually agreed upon subjects.

(B) In 1982, the U.S. side will send several persons to  
relevant laboratories in the PRC for cooperative studies on  
mutually agreed upon subjects.

# TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL COOPERATION IN EARTHQUAKE STUDIES

## DEPLOYMENT OF VERY LONG PERIOD SEISMOGRAPHIC STATIONS (IDA) AND COOPERATIVE RESEARCH

### I. General

A new network of very long period seismographic stations is being established around the world with the help of the National Science Foundation (NSF). This network is known as the IDA (International Deployment of Accelerometers) network. Each station will have a digitally recorded Lacoste-Romberg Gravimeter. Because of its size and geographical location, China is an obvious choice for one or more of these stations.

### II. Objective

To deploy an IDA station in the PRC for improved geographical distribution of the global IDA network. This network will provide observational data for the study of a number of fundamental geophysical problems.

### III. Scope

To install one IDA station at an appropriate location in Southwestern China. The installation of the instrument and the operation of the station shall be in accordance with the standard requirements and procedures of the IDA network. The U.S. side will provide the gravimeter and recording system, technical assistance in installation, on-site training for operators, supplies such as spare parts and magnetic tape, and will provide all the data from the entire IDA network. The PRC side will provide site preparation and construction of a suitable vault if necessary, maintenance and operation of the

IV. Implementation Plan for 1980

(A) Install an IDA station in Southwestern China. Kunming is the chosen site at the present time.

(B) During the first six months of 1980, the PRC side will consult with appropriate U.S. investigators about site preparation and complete all preparation work. During the second six months of 1980, the U.S. side will deliver all instruments and associate apparatus to the PRC for installation and will train station operators.

## ANNEX 7

### TO THE PROTOCOL FOR SCIENTIFIC AND TECHNICAL COOPERATION IN EARTHQUAKE STUDIES

#### EXCHANGE OF DATA AND FILMS OF SEISMOGRAMS

The purpose of this annex is to facilitate the exchange of earth science data and to enhance research efforts in seismology on a global basis by providing higher quality seismic data.

1. The National Geophysical and Solar-Terrestrial Data Center (NGSDC) of the National Oceanic and Atmospheric Administration (NOAA) will provide to the Institute of Geophysics (IOG) of the State Seismological Bureau the following equipment:

- (A) The panoramic microfilming camera specially designed to film seismograms;
- (B) Film for the above camera;
- (C) Chemicals for processing;
- (D) A table-top developing tank for processing the film;
- (E) Other expendable items necessary for photographing seismograms or developing film;
- (F) A machine which allows optical viewing of film and printing of seismograms.

This equipment shall remain with the Institute of Geophysics for the period of the activity described in the protocol.

A scientist and a microfilm equipment specialist of the National Oceanic and Atmospheric Administration shall supervise installation of the equipment at the Institute and demonstrate its operation and maintenance for a period of two weeks after

of equipment, and installation costs, shall be the responsibility of the IOG. Costs for unusual maintenance problems, repairs, and replacement of parts for the equipment shall be shared equally by both sides, subject to Article 4 of the Protocol.

The Institute shall furnish copies of microfilm records produced by the camera to the National Oceanic and Atmospheric Administration on a monthly basis during the period of the activity provided for in this Annex. During this period, the NGSDC shall furnish to the IOG at no cost and at the request of the IOG, the same number of microfilm records as the IOG furnishes to NGSDC. Microfilm records in excess of this number requested by the IOG will be supplied by NGSDC at cost. The Parties shall consult as appropriate to insure the scientific utility and continued availability of seismic data resulting from the carrying out of this agreement.

II. The State Seismological Bureau and the United States Geological Survey agree to exchange their publications that deal with areas of mutual interest as defined in Article 2 of this Protocol.

III. A plan for implementing the exchange of seismic data and publications and specifying the details of the arrangement will be prepared in 1960.